FORECASTING THE MAGNITUDE OF THE ABRASIVE WEAR OF THE HELICAL SURFACE OF THE PART

Zhachkin S.Yu.[1,2], Trifonov G.I.[1*]

[1]Military Educational Scientific Center Air force «Air force Academy named after Professor N.E. Zhukovsky and Y.A. Gagarin», Voronezh, Russia

[2]«Voronezh state technical University», Voronezh, Russia

E-mail: trifonov_gi@mail.ru

The problem of friction and wear is currently one of the most important in the operation of machines. However, more than 80% of all failures of machinery is associated with wear parts in friction [1].

The purpose of this work is to improve the calculation equations of the abrasive wear value, as well as the calculation of wear during micro-cutting of abrasive particles with plasma coating of the part surface.

To carry out research on the improvement of the calculated equations for predicting wear, a screw was selected, which is used in a screw conveyor. In a detailed analysis of the working conditions of the screw, the main types of wear were determined: abrasive.

In general, the amount of wear is determined by: $U = I_h \times L \times 10^{-6}$, where L – friction way, (*mkm*); I_h - the intensity of abrasive wear. It should be taken into account that the determination of the intensity of abrasive wear of the screw surface of the part is described by the authors in the work [2].

There are several assumptions that with increasing sliding speed the wear rate decreases rapidly, the wear depends on sliding speed, but only from the way of friction.

The friction path can be defined as $L = L_1 \times N_c$, where L_1 – the path of friction in one revolution of the screw (*mkm*), herewith $L_1 = \dfrac{\pi d}{\cos\psi}$, where N_c – number of cycles per run; ψ – the inclination of the helical surface; d – the inner diameter of the screw (*mkm*).

The number of cycles during operation is determined by [3] $N_c = 60 \times n \times t_h \times K_E$, where n – the frequency of rotation of the screw (*rpm*); t_h – operating time (*min*); K_E – equivalence ratio.

As a result, given the work [2], as well as the given scientific analysis, we make equations for calculating the wear value at elastic and plastic contact of abrasive particles with the surface, as well as wear at micro-cutting, we obtain:

$$U_1 = \frac{120 \times h^2 \times (r - \frac{1}{3}) n_a \times n \times t_h \times K_E}{m \times a \times n_p \times \left[R\sqrt{R^2 + h_1^2} + h_1^2 \ln \frac{R + \sqrt{R^2 + h_1^2}}{h_1} \right]} \times 10^{-6}$$
$$U_2 = \frac{60 \times h \times k \times n_a \times n \times t_h \times K_E}{m \times \pi \left[R\sqrt{R^2 + h_1^2} + h_1^2 \ln \frac{R + \sqrt{R^2 + h_1^2}}{h_1} \right]} \times 10^{-6} \qquad (1)$$

where U_1 – the wear value of the working surface of the screw, which is based on the fatigue nature of the destruction of the friction surface (*mkm*); U_2 – micro-cutting wear value (*mkm*); h – the depth of penetration of the particles (*mkm*); r – the averaged bulk particle radius (*mkm*); R – the external radius of the helical surface (*mkm*); n_a – number of particles in the friction zone; a – the radius of the contact spot (*mkm*); n_p – cycle number; m– the number of turns of the screw; h_1 – helix pitch.

1. Zhachkin S.Yu., Penkov N.A., Trifonov G.I. Journal « Science in the central Russia», №4 (28), 132 (2017).
2. Ikramov U.A. Computational methods for the evaluation of abrasive wear, M.: Mechanical Engineering (1987).
3. Zotov B.N. Machines and plants: design, development and operation. Electronic journal, № 03, 35 (2015).